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Universal Video Quality (UVQ) in YouTube
open source and production deployment insights

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YouTube's Requirements for Video Quality Assessment

- ## Handling UGC contents
  - to reflect various quality expectation and sensitivity

- ## Supporting no-reference
  - to support no-ref applications, e.g. monitoring uploads and live streaming
  - also work well in reference-based use cases, and be reliable to non-pristine reference

- ## Interpreting quality score
  - to help people better understand and solve quality issues

high quality expectation   v.s.   low sensitivity on quality

original (non-pristine)   v.s.   transcoded version

compression artifacts   v.s.   codec/transmission error

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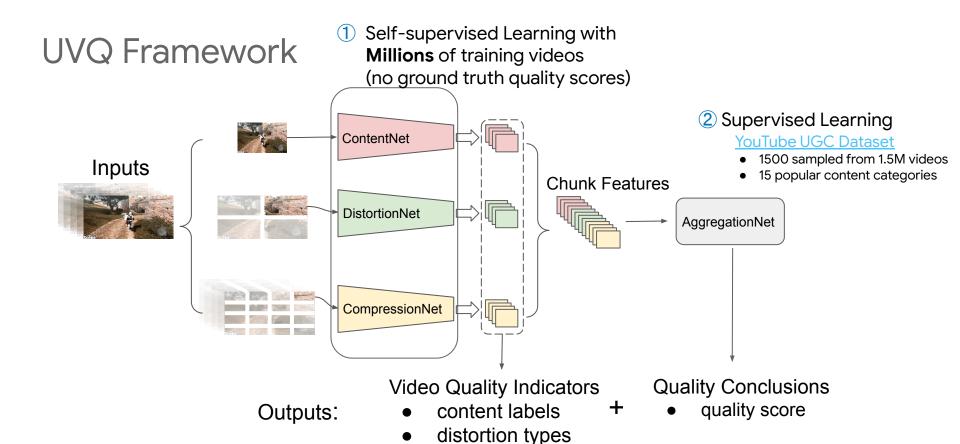# UVQ: a **No-Ref** based **Interpretable** quality model for **UGC**

UVQ Quality Report:

Overall quality score in [1, 5]

- Interpretation of UVQ scores
  - [1, 3.5): relatively low
  - [3.5, 4.2]: medium/fair
  - [4.2, 5]: relatively high
- Noticeable diff: 0.05~0.1 UVQ DMOS
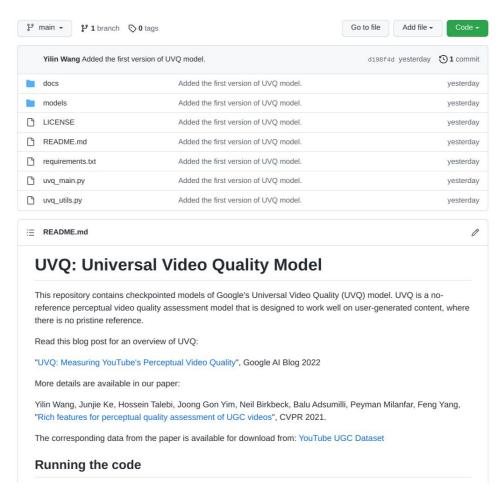- Score for this example: 3.15 (low quality)

Quality labels

- From high level (semantic) to low level (pixel difference)
- Labels for this example
  - Strategy video game,
  - Gaussian blur, Pixelate
  - Medium high compression

UVQ Framework

① Self-supervised Learning with **Millions** of training videos (no ground truth quality scores)

Inputs

ContentNet

DistortionNet

CompressionNet

Chunk Features

② Supervised Learning
YouTube UGC Dataset
- 1500 sampled from 1.5M videos
- 15 popular content categories

AggregationNet

Outputs:

Video Quality Indicators
- content labels
- distortion types
- compression level

+

Quality Conclusions
- quality score

Yilin Wang et al., "Rich features for perceptual quality assessment of UGC videos", CVPR 2021

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UVQ has been open sourced!

- Public link: github.com/google/uvq
- In the folder
  - UVQ models + runnable scripts
- Input
  - "video_id,length,filepath"
- Outputs
  - **overall scores** + **labels** + **raw features**

main ▾		♪ 1 branch	◦ 0 tags			Go to file	Add file ▾	Code ▾

	Yilin Wang Added the first version of UVQ model.		d198f4d yesterday	⟳ 1 commit
📁	docs	Added the first version of UVQ model.	yesterday
📁	models	Added the first version of UVQ model.	yesterday
📄	LICENSE	Added the first version of UVQ model.	yesterday
📄	README.md	Added the first version of UVQ model.	yesterday
📄	requirements.txt	Added the first version of UVQ model.	yesterday
📄	uvq_main.py	Added the first version of UVQ model.	yesterday
📄	uvq_utils.py	Added the first version of UVQ model.	yesterday

☰ **README.md** ✎

UVQ: Universal Video Quality Model

This repository contains checkpointed models of Google's Universal Video Quality (UVQ) model. UVQ is a no-reference perceptual video quality assessment model that is designed to work well on user-generated content, where there is no pristine reference.

Read this blog post for an overview of UVQ:

"UVQ: Measuring YouTube's Perceptual Video Quality", Google AI Blog 2022

More details are available in our paper:

Yilin Wang, Junjie Ke, Hossein Talebi, Joong Gon Yim, Neil Birkbeck, Balu Adsumilli, Peyman Milanfar, Feng Yang, "Rich features for perceptual quality assessment of UGC videos", CVPR 2021.

The corresponding data from the paper is available for download from: YouTube UGC Dataset

Running the code

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UVQ Applications in YouTube

Monitor	**Detector**	**Feature**	**Optimizer**
Production quality	Specific quality issues	Useful signals for quality-related services	Making decision or optimization based on quality
• VOD, Shorts • Live, TV • Launch Evaluation	• Release Validation • Ingestion • Codec Evaluation	• Search & Recommendation	• Transcoding Optimization • Video Enhancement

Model efficiency becomes critical for large scale applications.

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Revisiting the Efficiency of UGC Video Quality Assessment

Yilin Wang, Joong Gon Yim, Neil Birkbeck, Junjie Ke, Hossein Talebi, Xi Chen, Feng Yang, Balu Adsumilli

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Current UGC-VQA Research

Small Training Set

Dataset	Videos
LIVE-VQC	585
KonVid-1k	1,000
YouTube-UGC	1,500
LSVQ	40,000
...	

Huge Model

Name	Backbone	Params
VSFA	ResNet-50	> 23M
PVQ	2D and 3D ResNet-18	> 44M
UVQ (CoINVQ)	D3D and EfficientNet	43.1M
Fast-VQA	Swin-Transformer	27.5M
...		

Do we really need such high complexity models, given the limited scale of UGC data?

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Possibility to Reduce Model Complexity

- UVQ-lite: replacing UVQ's backbones with smaller ones
  - D3D -> MoViNet
  - EfficientNet -> MobileNet
- Significant complexity reduction
  - Model parameters is reduced by **83.1%**
  - Flops is reduced by **92.1%**

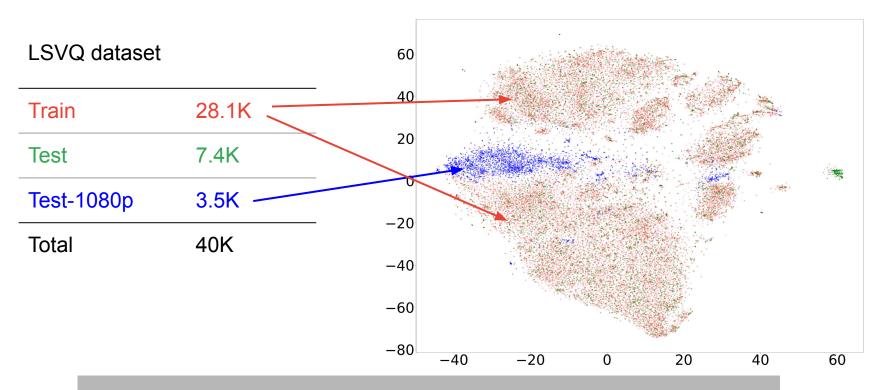|	UVQ				UVQ-lite			
	Compres-sionNet	Content Net	Distor-tionNet	Total	Compres-sionNet	Content Net	Distor-tionNet	Total
Backbone	D3D	Efficient Net-b0	Efficient Net-b0		MoViNet-A0	Mobile Net-0.35	Mobile Net-0.2	
Parameters(M)	16.382	12.177	14.566	43.126	1.160	3.611	2.531	7.304 (83% drop)
Flops(G)	12.792	4.229	4.259	21.281	0.967	0.360	0.367	1.696 (92% drop)

How does the small model UVQ-lite perform?

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Model Performance

- UVQ-lite outperforms larger models (VSFA and TLVQM) on LSVQ test set
- UVQ-lite also achieves highest correlations on LSVQ Test 1080p set

Model	LSVQ Test		LSVQ Test-1080p		Model
	PLCC	SRCC	PLCC	SRCC	Params
TLVQM	0.774	0.772	0.616	0.589	–
VSFA	0.796	0.801	0.704	0.675	> 23M
PVQ (w/o v-patch)	**0.816**	0.814	0.708	0.686	> 44M
UVQ	0.809	**0.815**	0.717	0.685	43.1M
UVQ-lite	0.798	0.806	**0.718**	**0.690**	**7.3M**

t-SNE Visualized UVQ Features (Distortion Features for LSVQ)

LSVQ dataset	
Train	28.1K
Test	7.4K
Test-1080p	3.5K
Total	40K

The coverage of existing dataset still needs improvement.

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Summary

- UVQ is open source now!
  - github.com/google/uvq

- Efficiency of UGC-VQA is important and insufficiently addressed
  - existing datasets may not fully represent the complexity of UGC video quality
  - we can design more efficient models with better generalizability for UGC-VQA tasks

- Frontiers' research topic on image/video quality
  - deadline: Aug 1st, 2023

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Thanks!

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